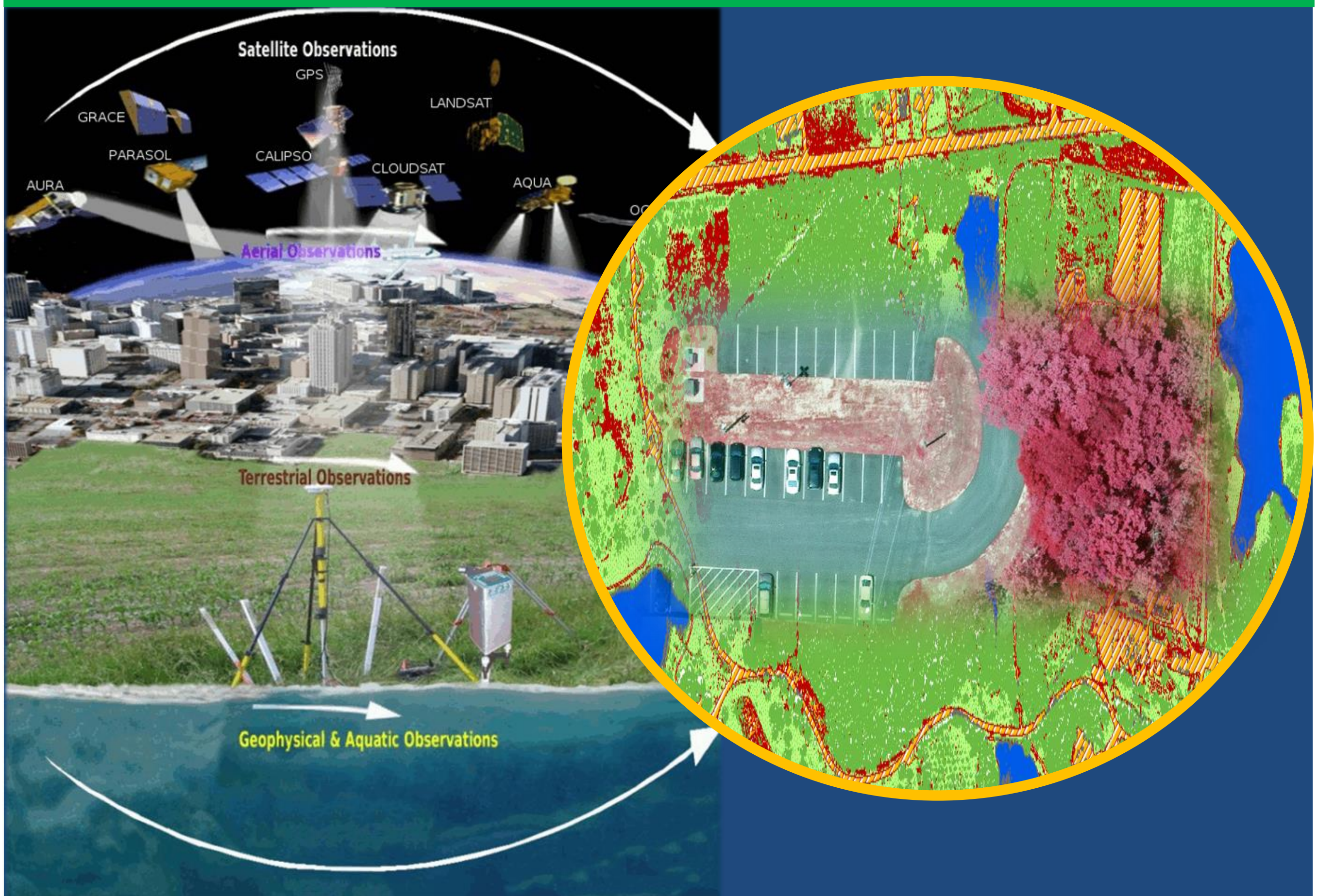
IMPERVIOUS SURFACE MAPPING UTILIZING HIGH RESOLUTION IMAGERIES



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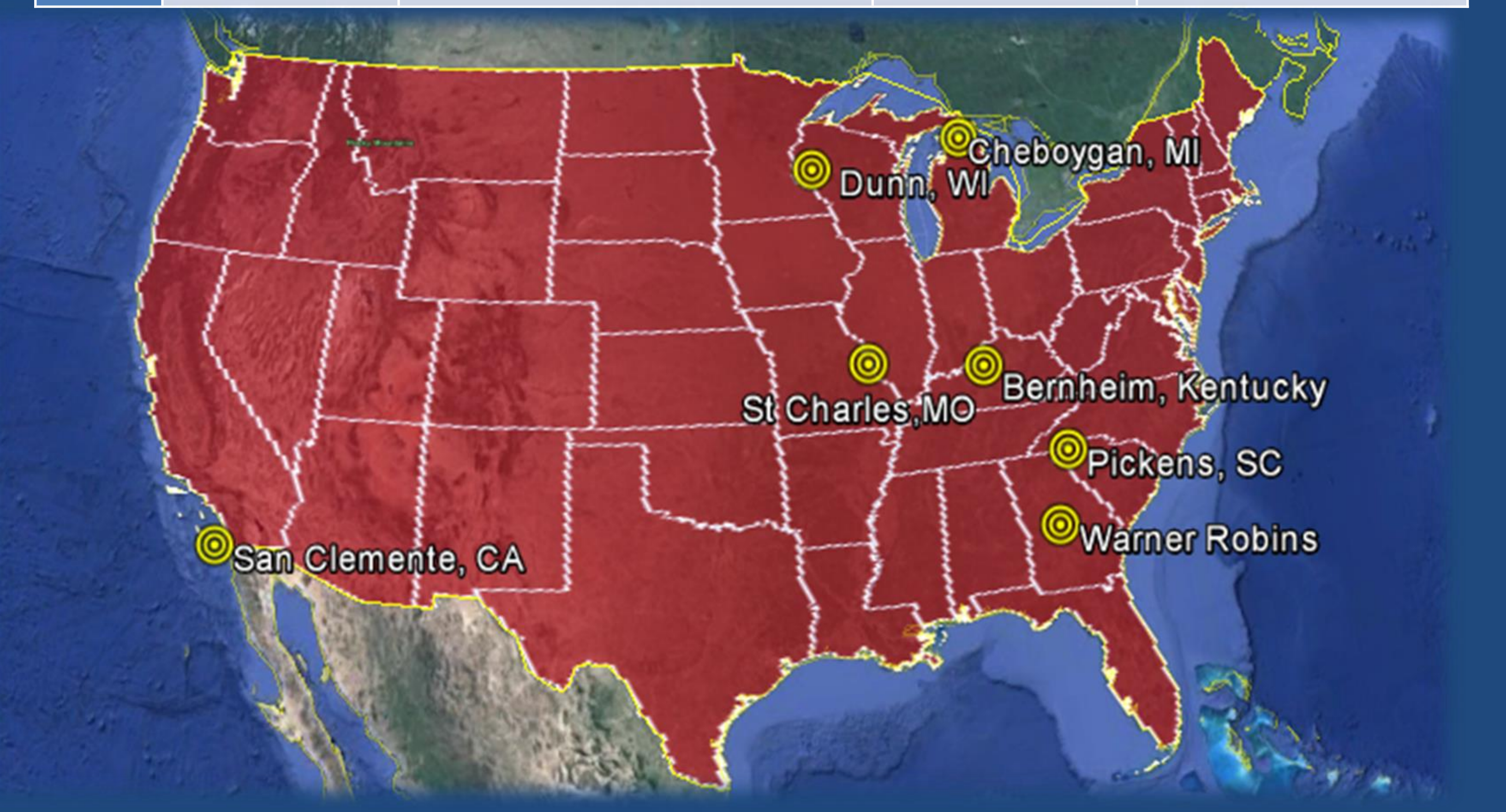
ABSTRACT

Accurate mapping of artificial or natural impervious surfaces is critical for climate change studies, waste and storm water engineering and management, and ground water preservation. Diverse geology, climatic zones, topography, drainage systems, and geographic regions will have different impacts of impervious surfaces on climate engineering. This study will perform image classification of different spatial resolutions: 3-cm, 5-cm, 7.5-cm, 15-cm, and 30-cm orthoimageries to map the impervious surfaces from different geographic regions: California, Georgia, Kentucky, Missouri, Michigan, Wisconsin, and South Carolina. City of San Clemente California is a coastal city, which has topography from zero elevation to eight hundred feet with a short distance, Warner Robins is a suburb of city of Macon, GA, Pickens County, South Carolina has plain to mountainous areas south of Smoky Mountain, Bernheim Arboretum and Research Forest is close to City of Louisville, Kentucky, Emmet and Cheboygan Counties border with Lake Michigan, St. Charles County is a suburb of City of St. Louise, and Dunn County, Wisconsin is a rural county. The sample imageries taken from different geographic regions for this study will be standardized for similar in size and scopes. Modeler will be used to create a classification model for the study site in Kentucky. The model developed will be utilized for the other study areas. Ground truthing will be performed for the site in Kentucky. For the other study areas automatic statistical analysis will be performed for getting precision of the impervious surface data produced.

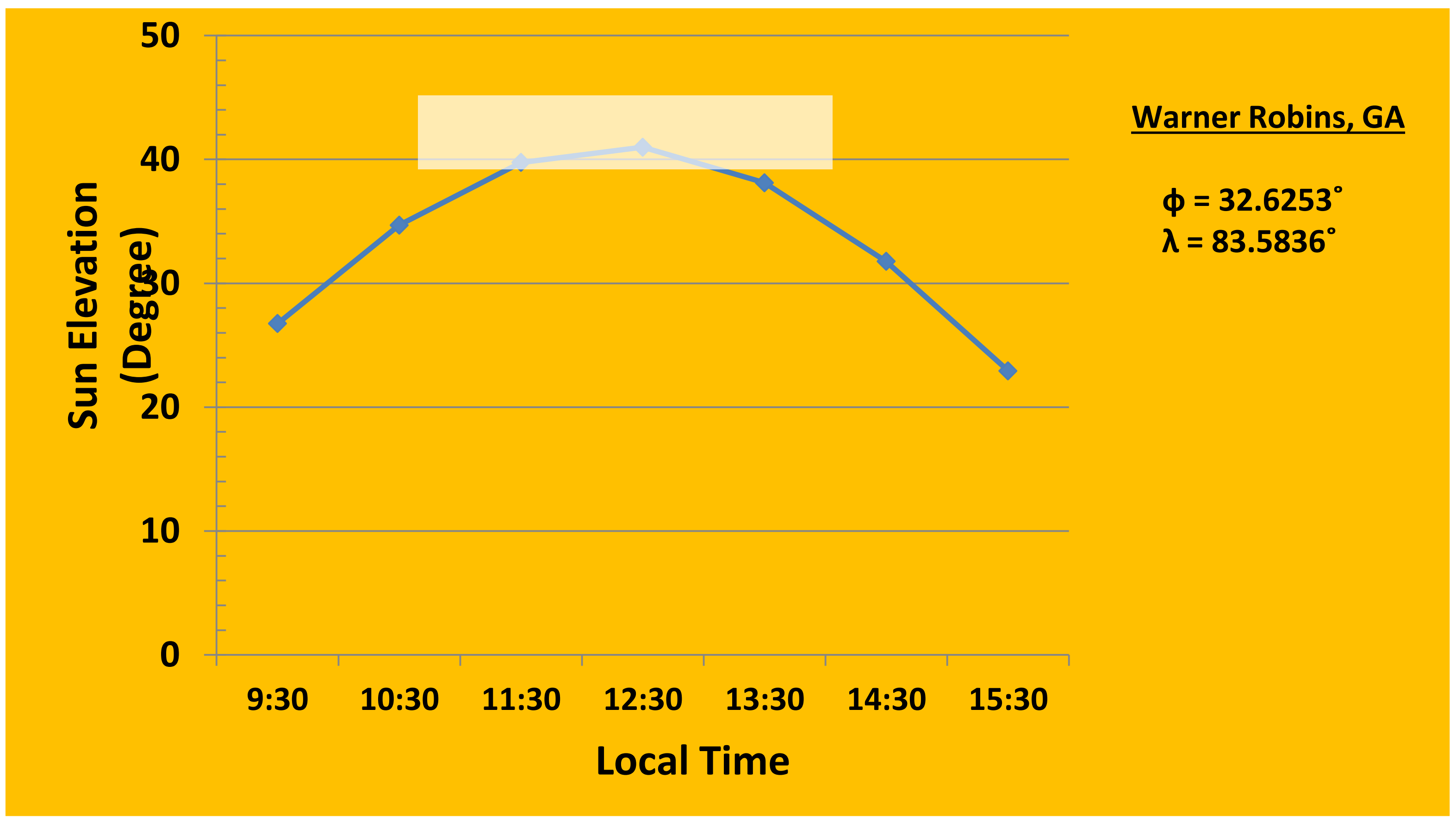
1. Preliminary Study of Secondary Data Collection in Various Geographic Regions
2. Impact s of Image Resolutions and Shadows
3. Quality of Input Data
4. Accuracy of Secondary Data Extracted

DATA USED

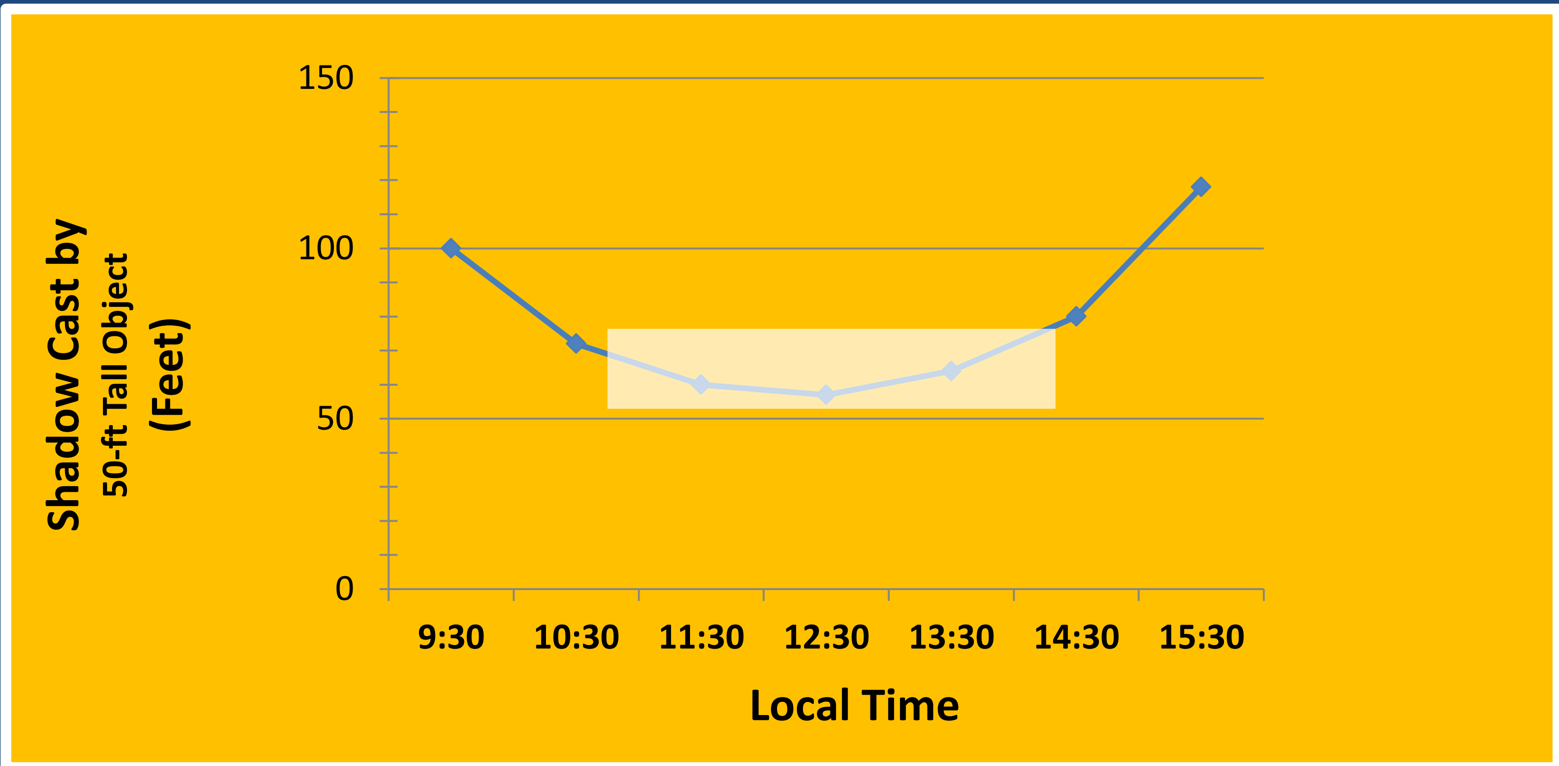
S. N.	Date of Data	Type of Data and Sensor	Resolution	Remarks
1	2013	Color & CIR Imageries, Bernheim Kentucky	5-cm	DMC Camera
2	2010	San Clemente, California	7.5-cm	Analog RC-30
3	2010	St Charles, MO	15-cm	DMC
4	2008	Dunn County, WI	15-cm	DMC
5	2008	Emmett County, MI	15-cm	DMC
6	2008	Pickens County, SC	15-cm, 30-cm	RC-30
7	2007	Warner Robins, GA	3-cm	RC-30



SUN ELEVATION VS. SHADOW



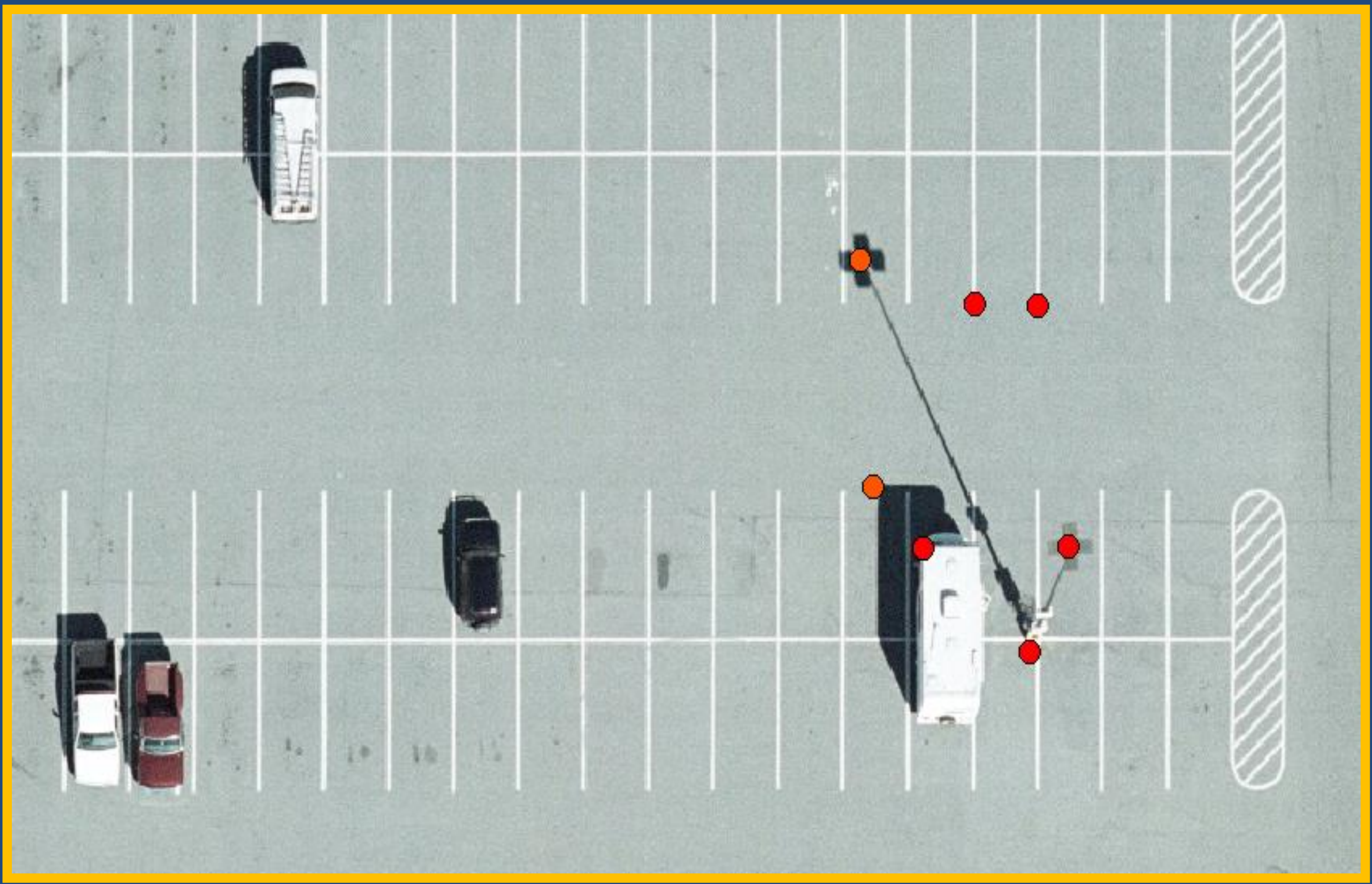
Sun Angle vs. Shadow



SUN ELEVATION VS. SHADOW CONT'D..

Shadow (s) = Height of the Object (h) ÷ Tan (Sun Elevation)

$$s = h/\tan(\alpha);\ h = 45'$$



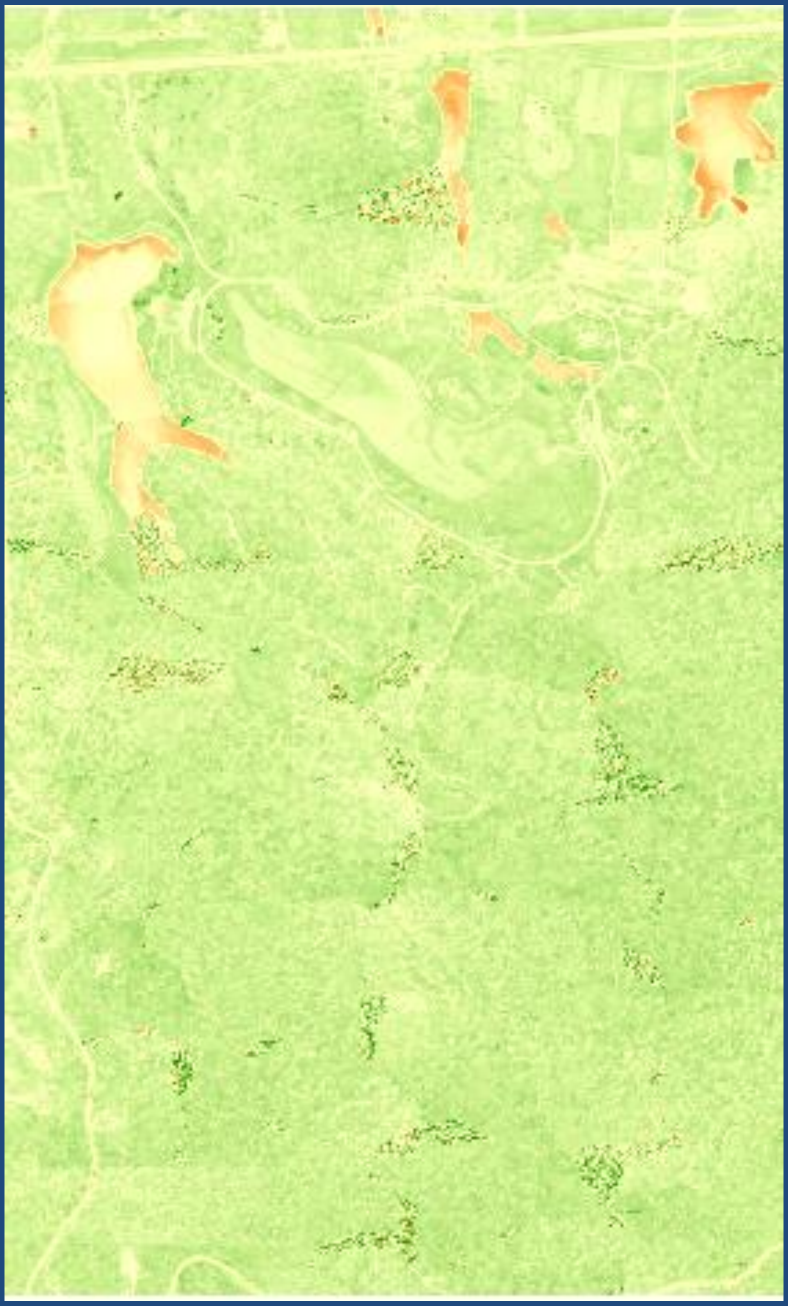
Relief Displacement (d) = Height of the Camera (H) x Radial Displacement (r) ÷ Height of Object (h)

$$d = H*r/h$$

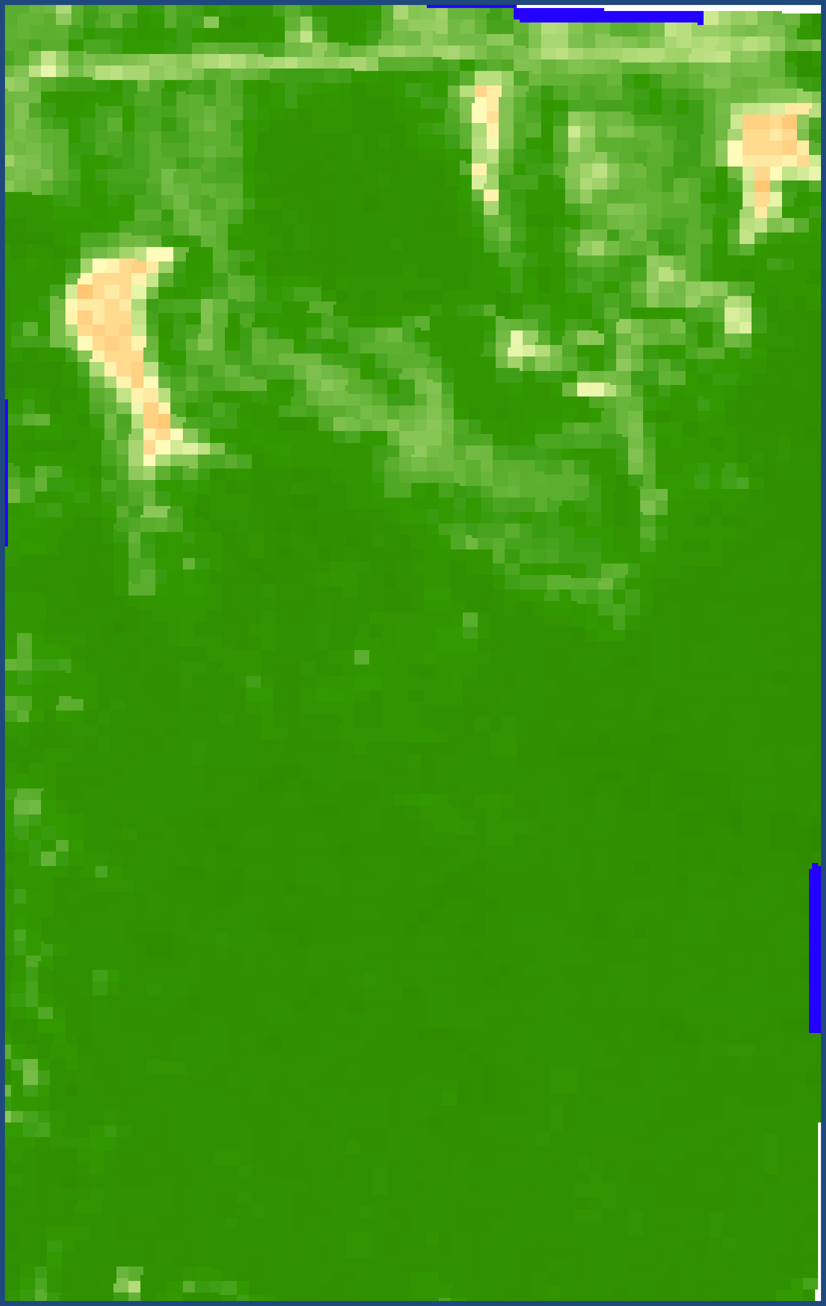
or

$$h = H*r/d = 2000 * 0.260/12 = 43.3'$$

IMAGE CLASSIFICATION OF THE STUDY SITE: BERNHEIM KENTUCKY



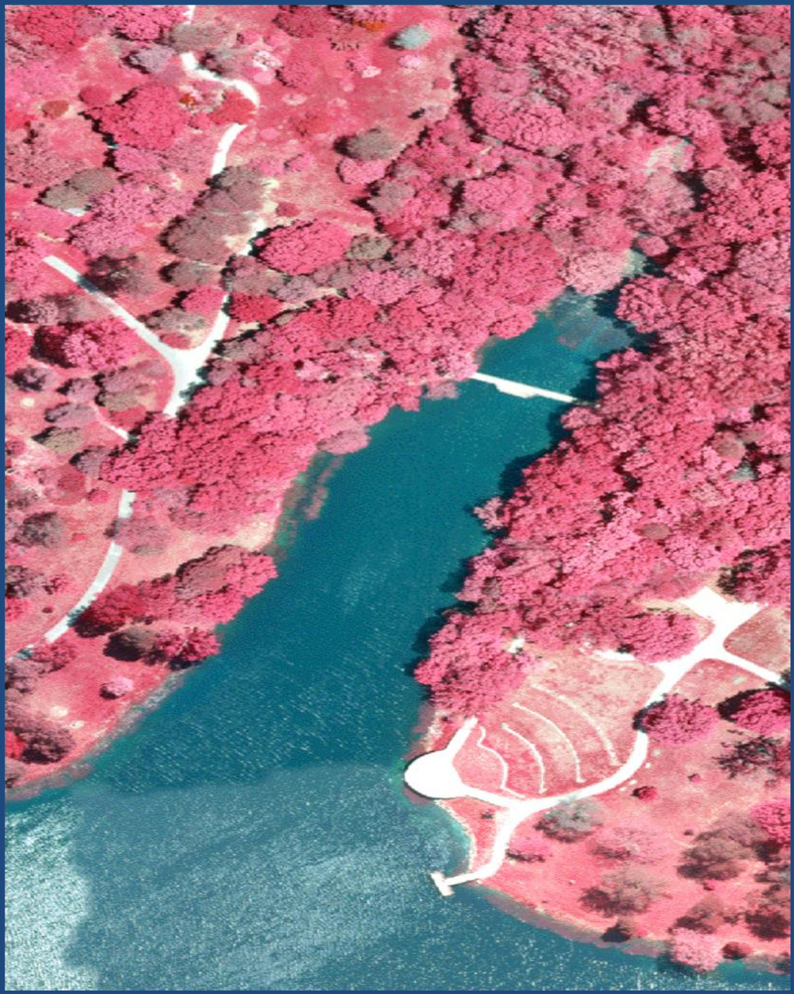
NDVI from 5-cm Ortho Mosaic

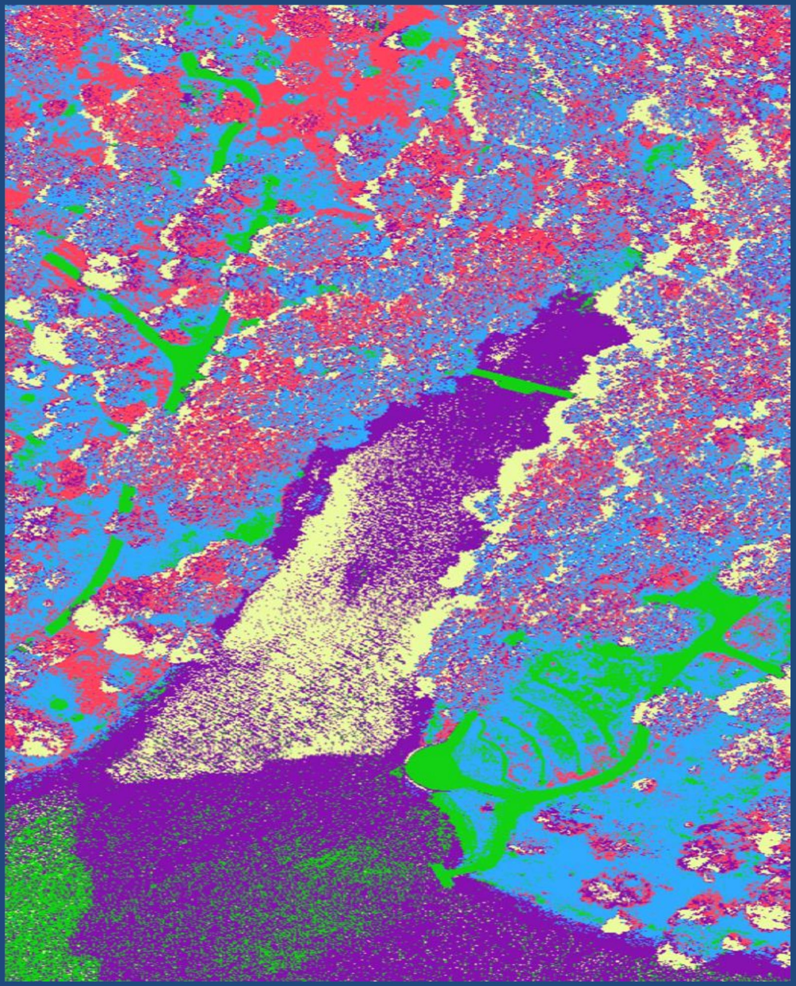


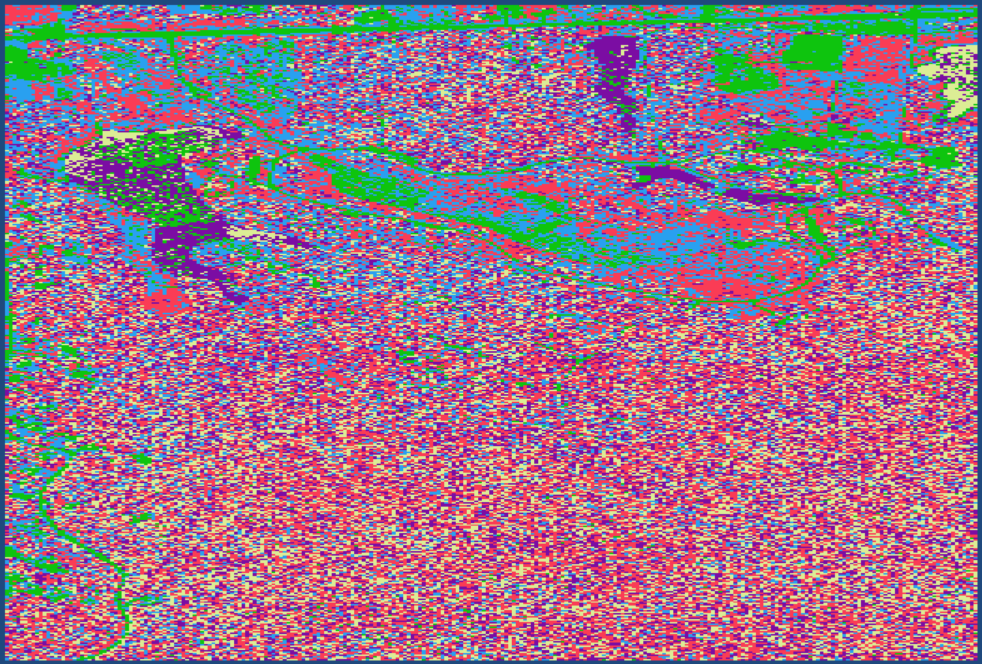
NDVI from 15-m LANDSAT ETM

NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI) shows comparatively far less details in the Landsat ETM. NDVI assists in checking the density of vegetation for any area of interest.

IMAGE CLASSIFICATION OF THE STUDY SITE: BERNHEIM, KENTUCKY CONT'D..

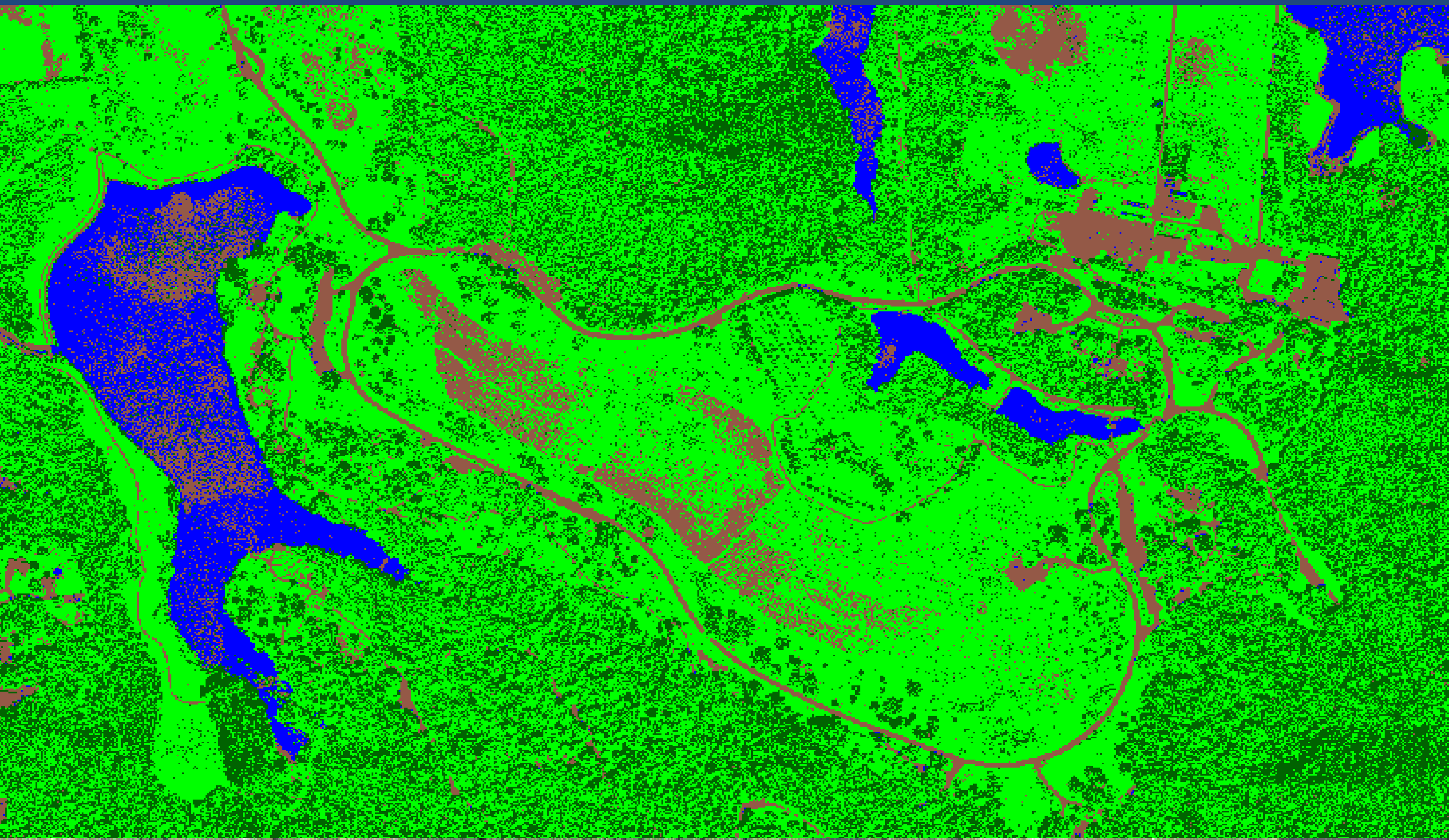






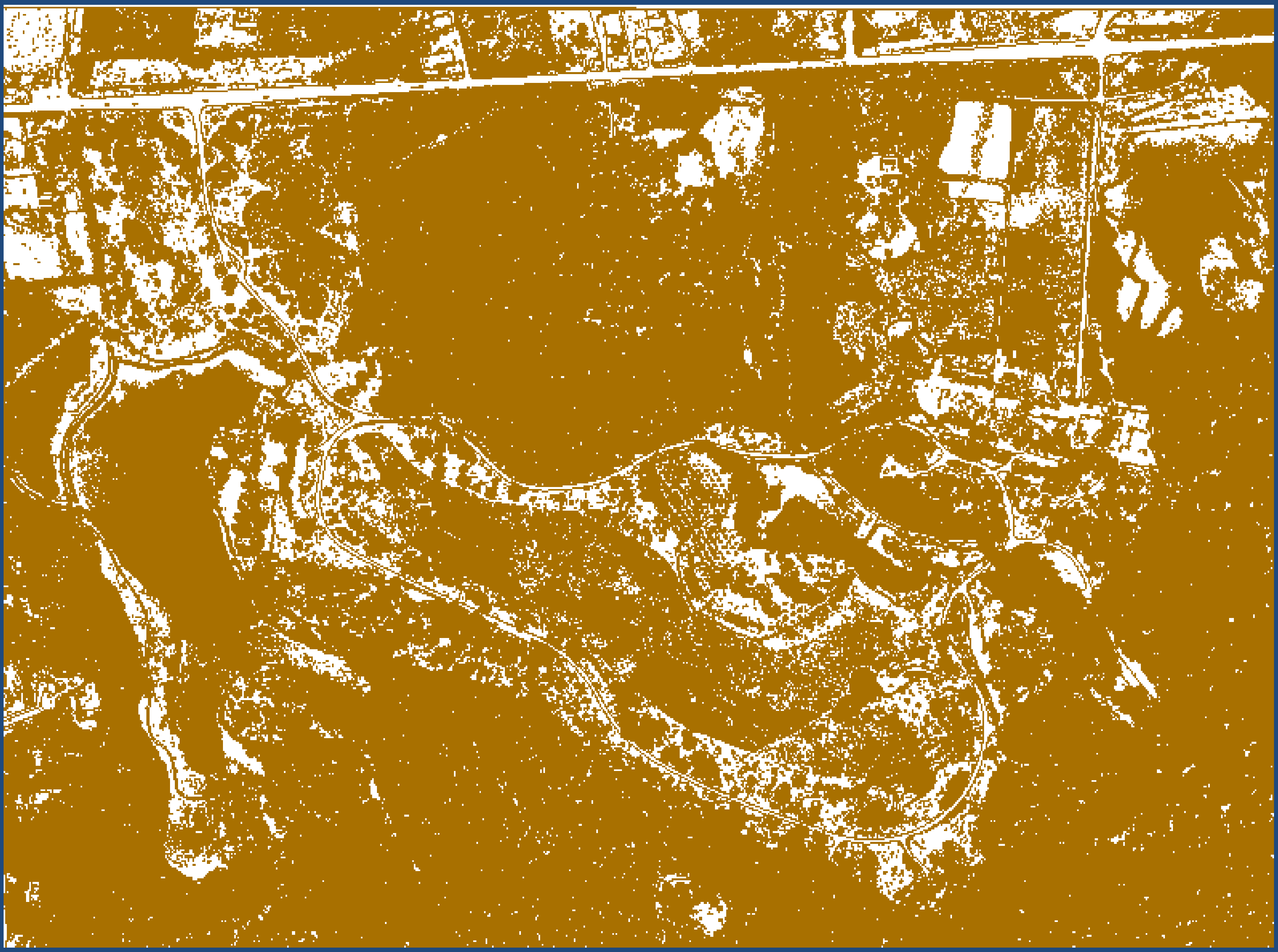
60 classes Using Unsupervised Classification

IMAGE CLASSIFICATION OF THE STUDY SITE: BERNHEIM, KENTUCKY CONT'D..



Zoomed in Area of Bernheim Arboretum

IMAGE CLASSIFICATION OF THE STUDY SITE: BERNHEIM, KENTUCKY CONT'D..



Vectorized Impervious Surface Map

BENEFITS OF VECTOR DATA:

RESOURCES QUANTIFICATION

DATA SIZE

GIS MODELING

IMAGE CLASSIFICATION OF THE STUDY SITE: WARNER ROBINS, GEORGIA

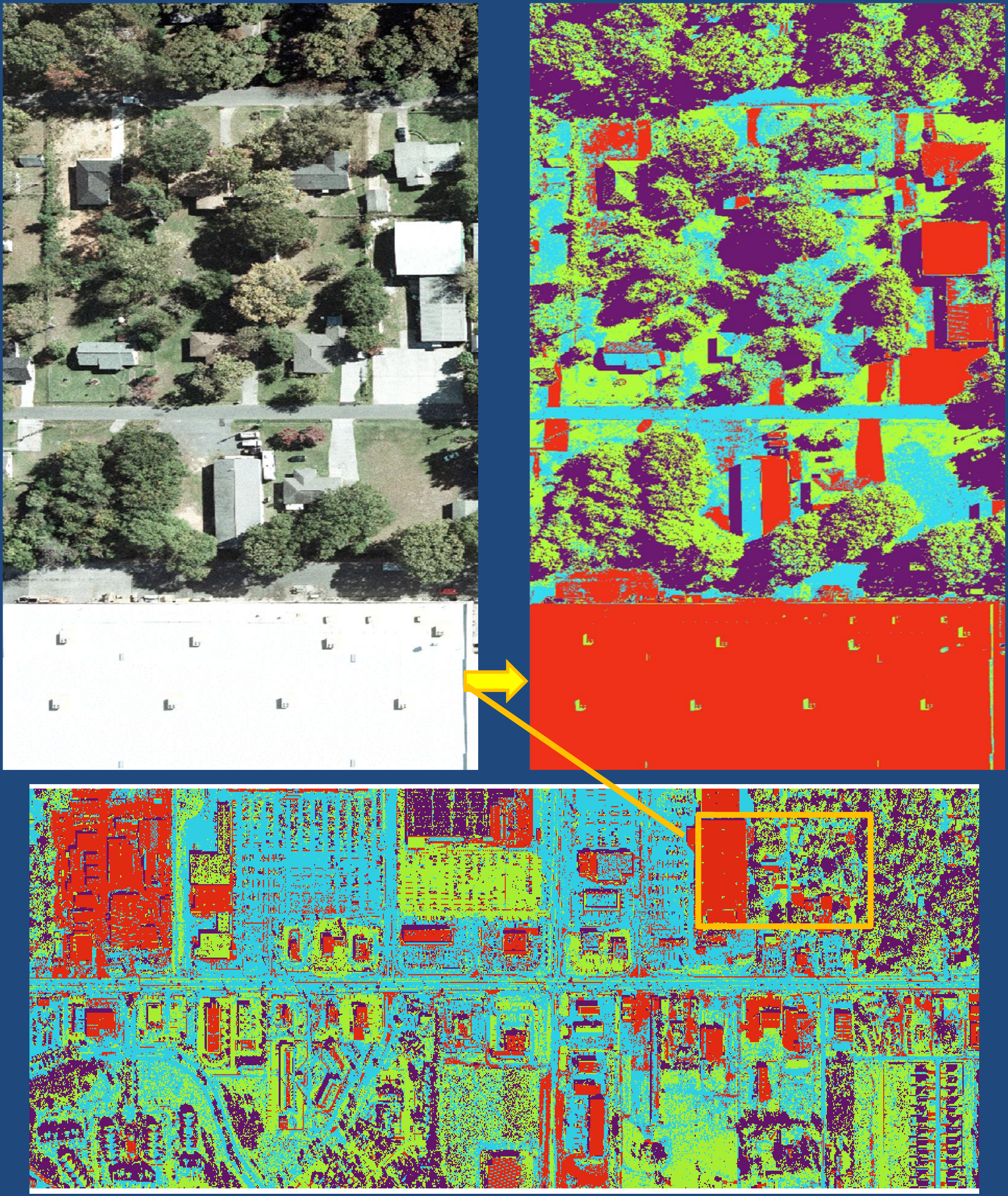


IMAGE CLASSIFICATION OF THE STUDY SITE: PICKENS COUNTY SOUTH CAROLINA

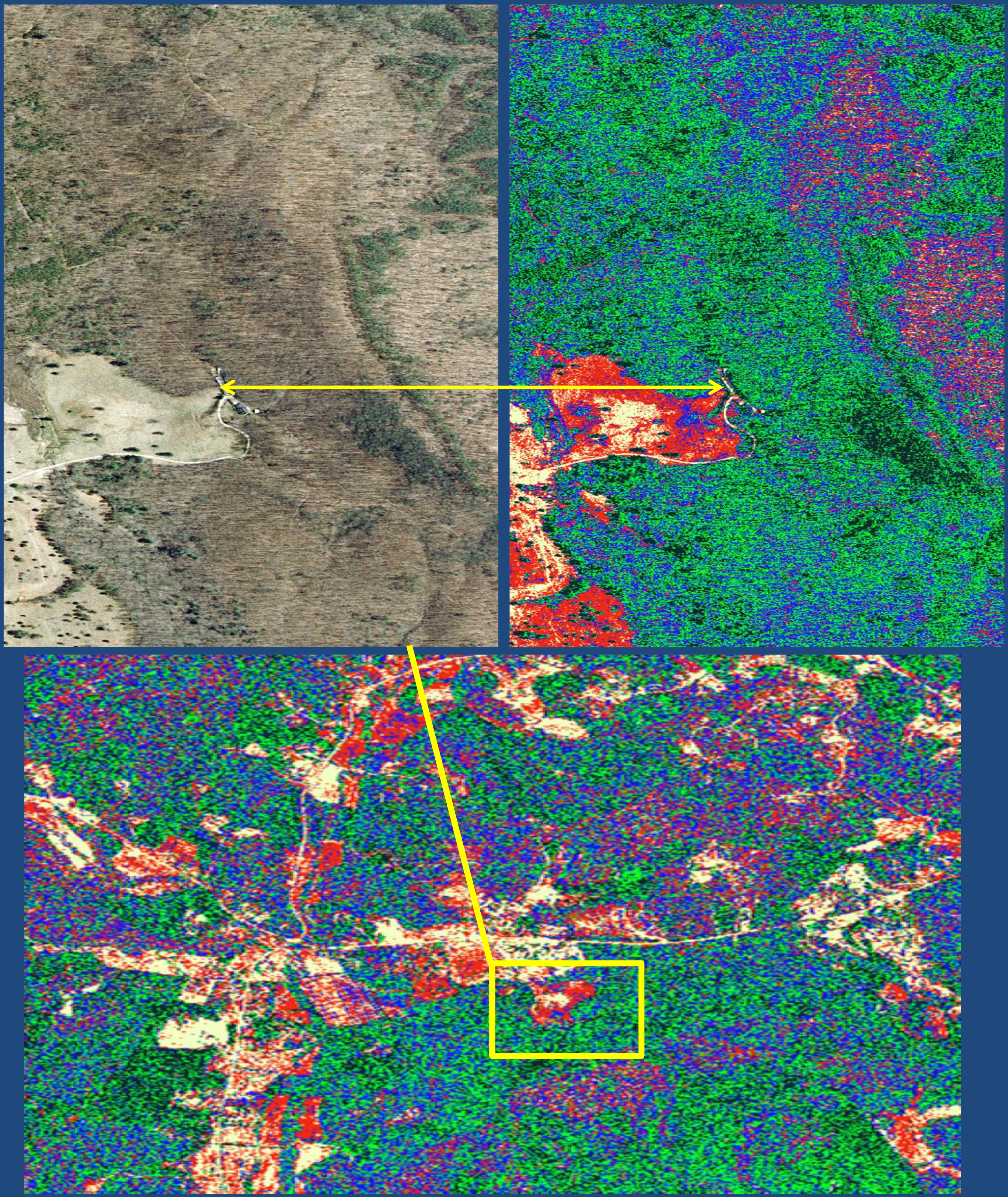


IMAGE CLASSIFICATION OF THE STUDY SITE: EMMET COUNTY MICHIGAN

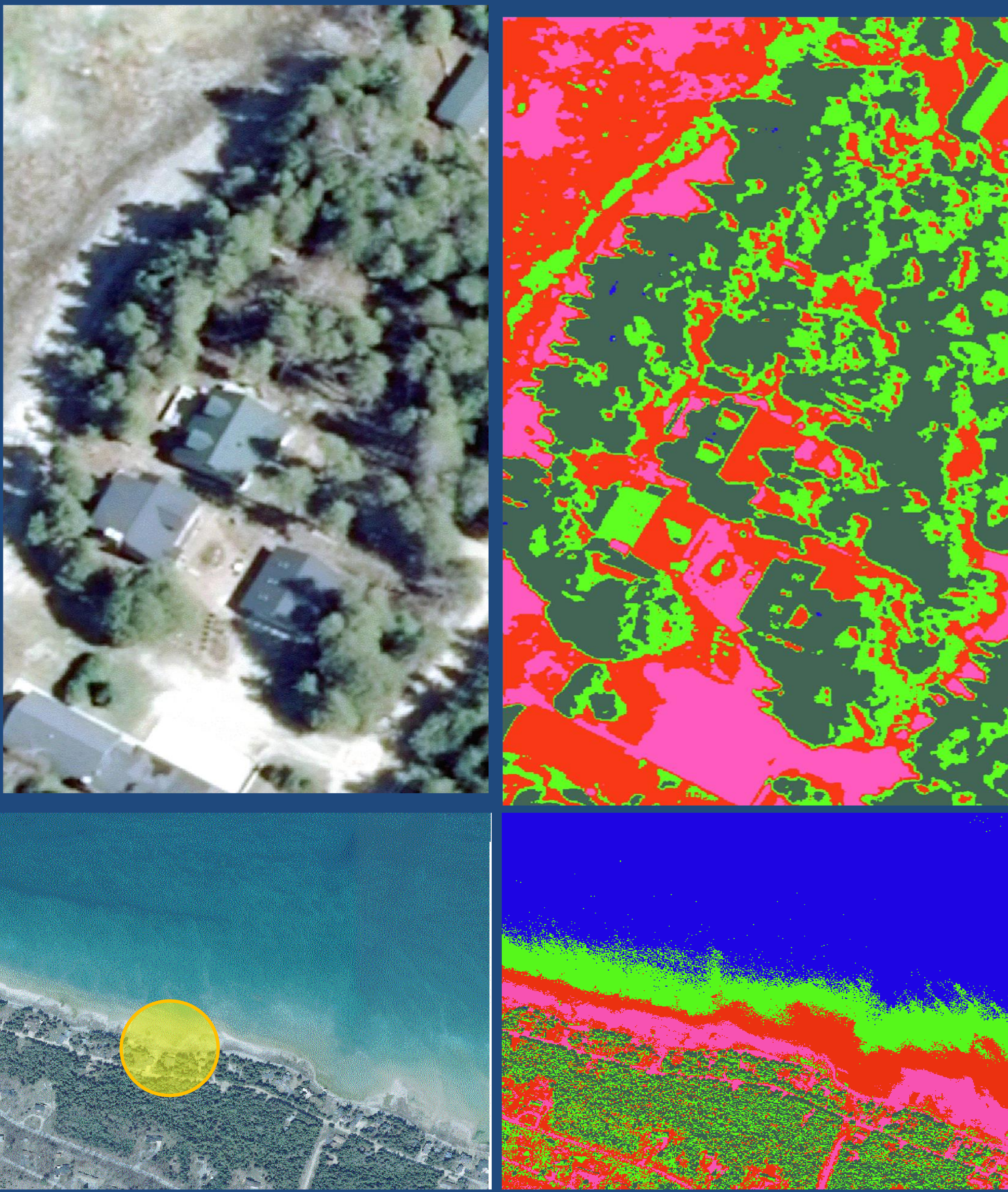
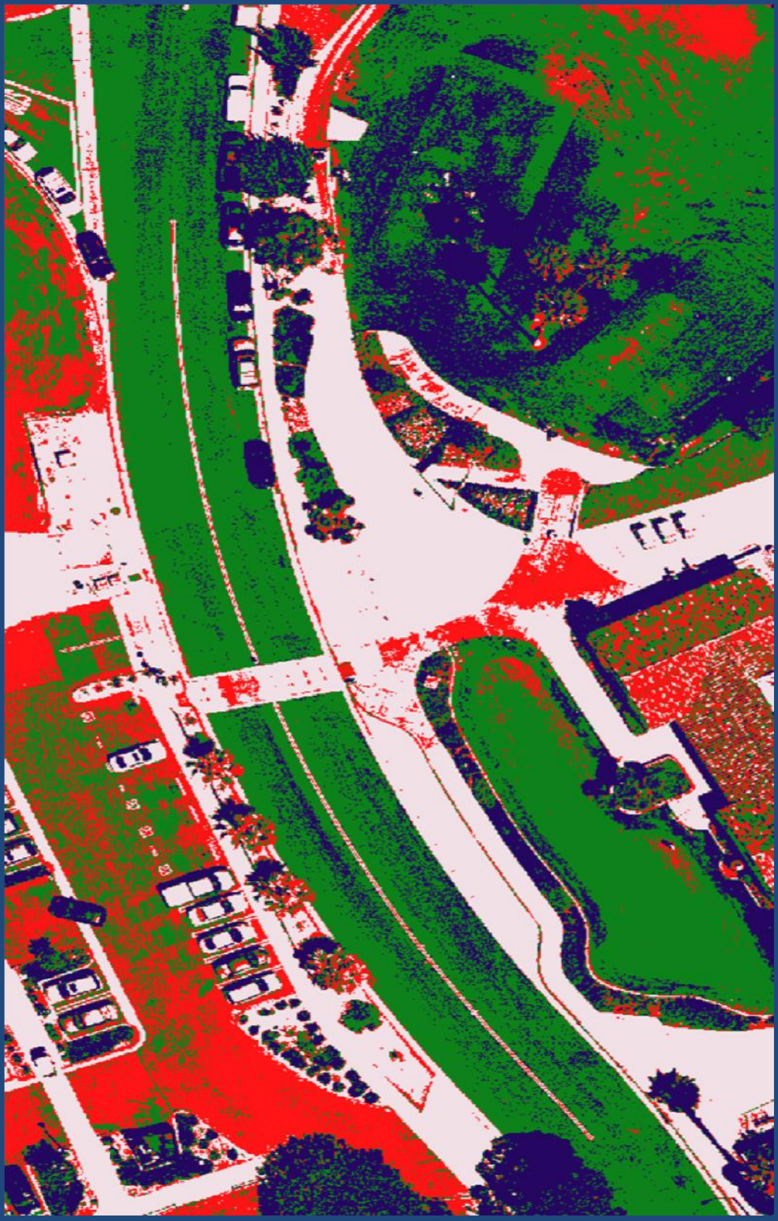


IMAGE CLASSIFICATION OF THE STUDY SITE: SAN CLEMENTE, CALIFORNIA



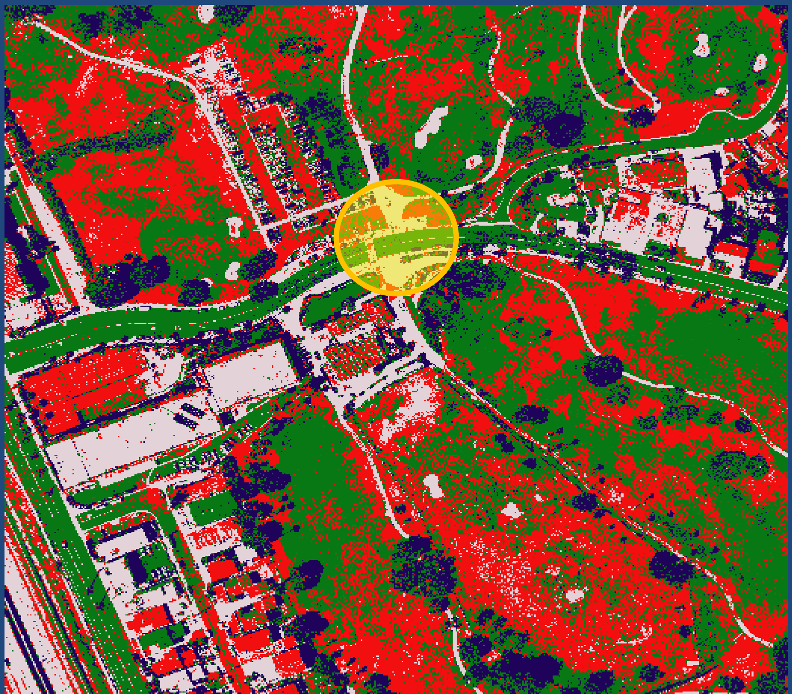
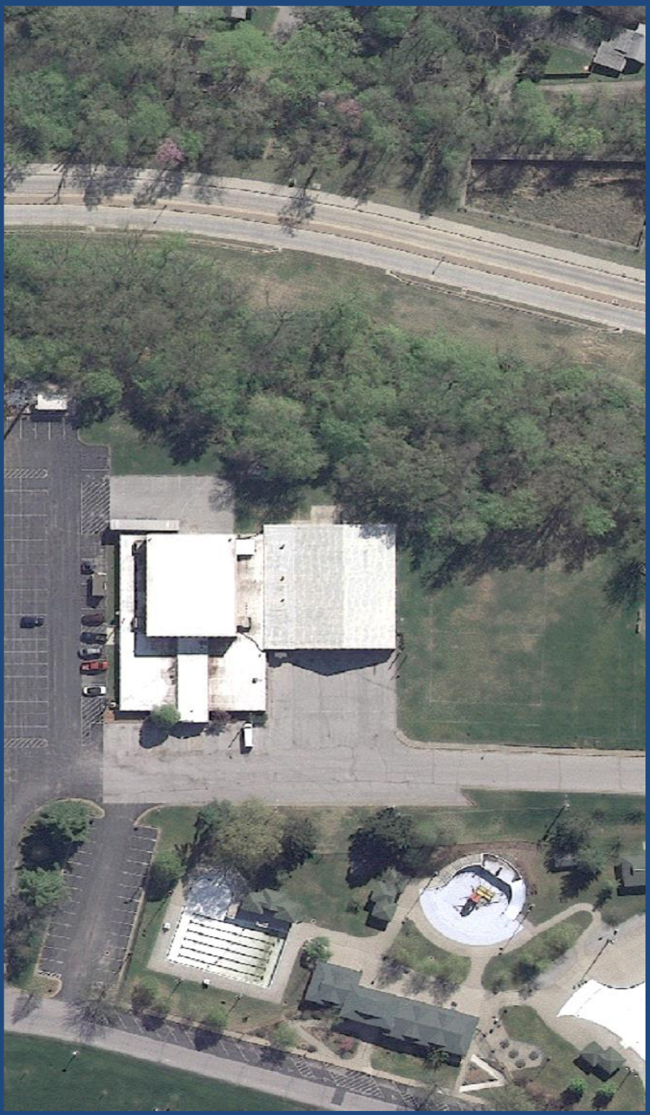
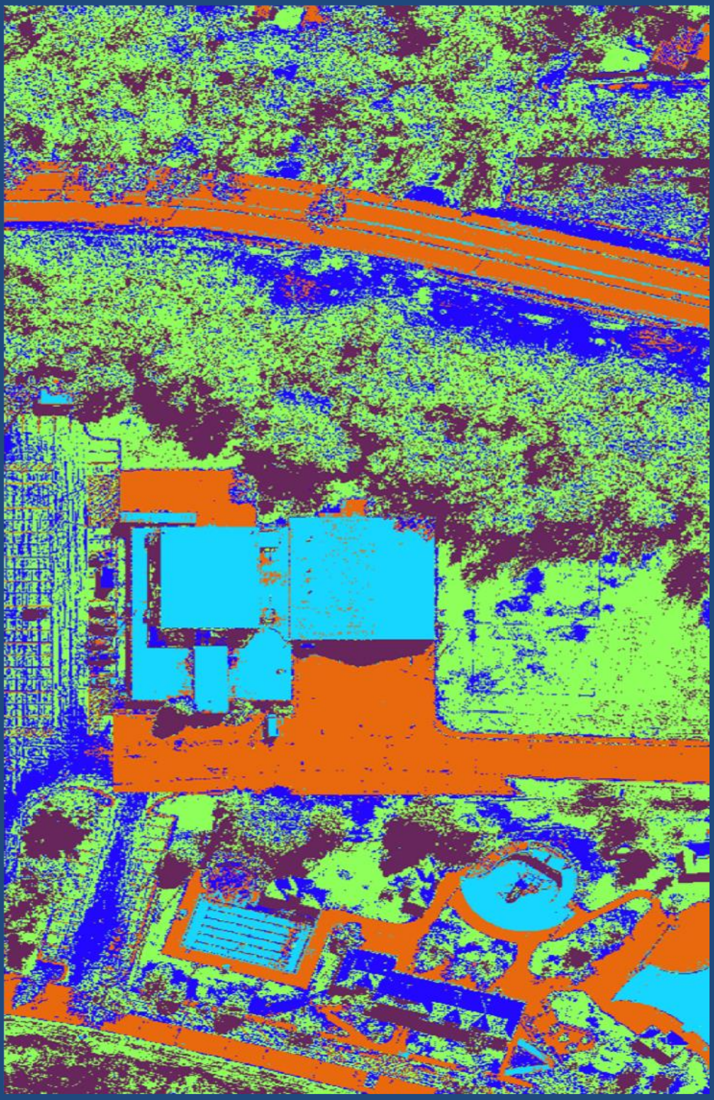


IMAGE CLASSIFICATION OF THE STUDY SITE: ST. CHARLES COUNTY, MISSOURI





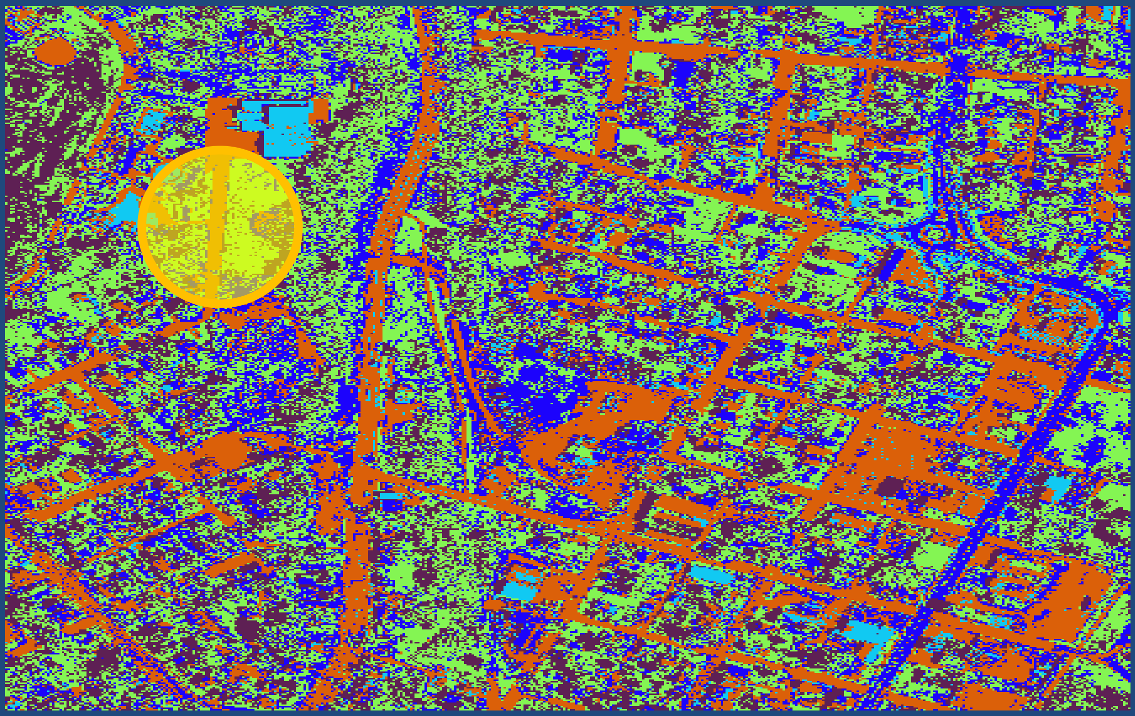


IMAGE CLASSIFICATION OF THE STUDY SITE: DUNN COUNTY, WISCONSIN

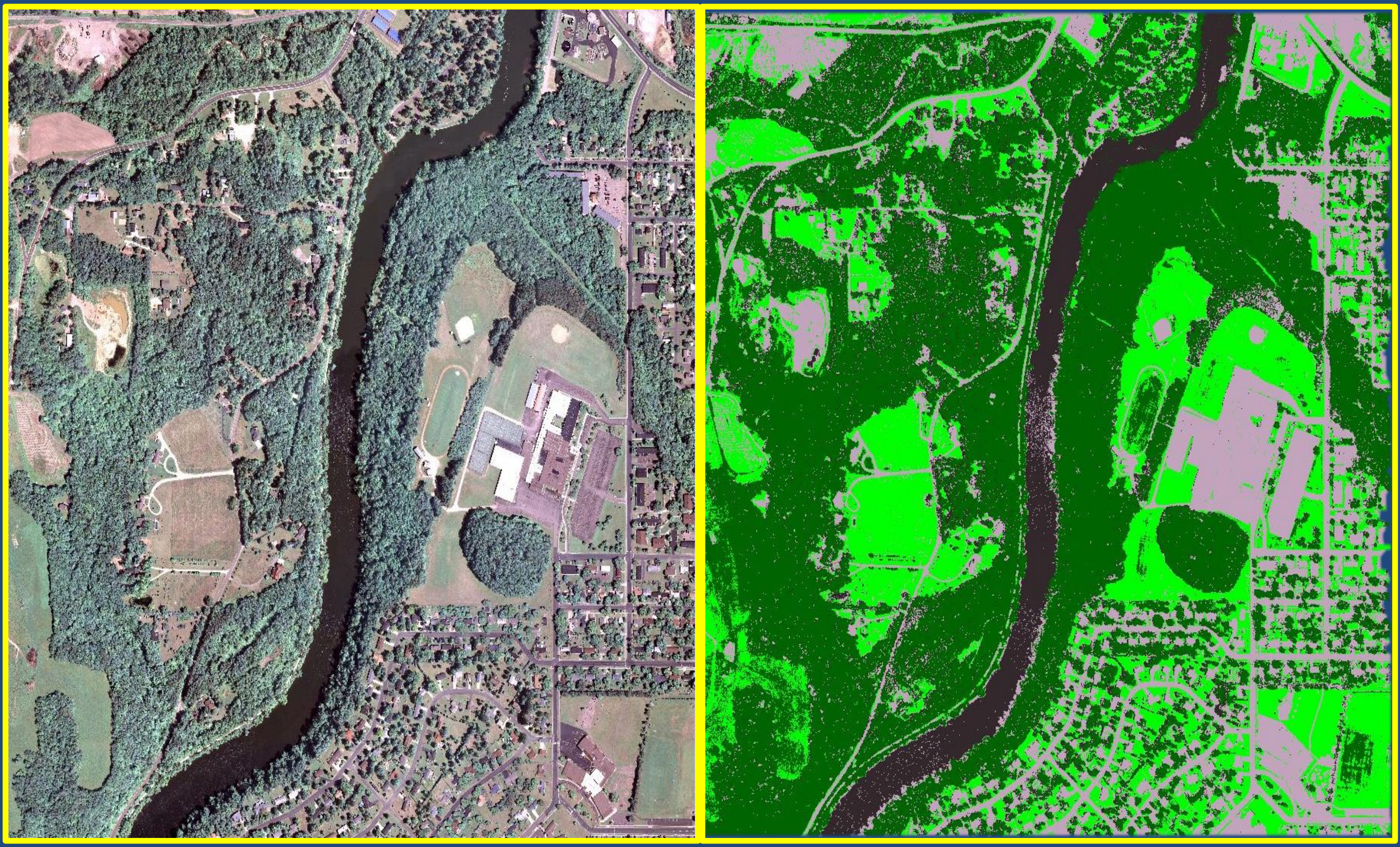


Image classifications using the High Resolution Imageries from Various of Part of Country Reveal that Auto Classification of Imageries Provide Vast Information that should be Optimized .

AUTOMATIC EXTRACTION OF SECONDARY DATA UTILIZING HIGH RESOLUTION & PRECISION IMAGERIES

High Precision and Resolution Orthoimagery

No Human Induced Error

Cost Effective & Efficient

Detailed Impervious & Planimetric Data

Consistency with Orthoimagery

Retains Statistical Data

Automatic Meta Data Generation

Requires Generalization

Requires Raster to Vector Conversion

ACCURACY STANDARDS

Geodetic Control Points Govern the **Accuracy** of all Geospatial Data

<u>WHY NEED ACCURACY STANDARDS?</u>

Geospatial data is utilized for:

- Natural Resources: Inventorying, Planning, and Optimization of Land, Water, Vegetation, Minerals
- Infrastructure Development
- Research Modeling and Simulations
- Forecasting: Local, Regional, and Continental

Accuracy = CS + CLM + RR + PS

Where,

CS	= Cost Saving
CLM	= Confidence Level Measure
RR	= Risk Reduction
PS	= Project Success

Standards are the specifications to be followed during a project implementation to meet the accuracy defined or desired.

PROBLEMS OF UTILIZING HIGH RESOLUTION IMAGERIES

- DATA SIZE
- PROCESSING TIME
- SHADOWS
- RELIEF DISPLACEMENTS
- TEXTURE
- GEOMETRY
- PATTERNS
- COLOR
- NO SIGNATURE LIBRARIES
- CLASSIFICATION TECHNIQUES NOT SUITABLE FOR HIGH RESOLUTION AIRBORNE IMAGERIES

OPTIMIZATION OF HIGH RESOLUTION IMAGERIES

UTILIZE HIGH RESOLUTION IMAGERIES FOR EXTRACTING BASELINE DATA

RESAMPLE THE IMAGERIES TO USE IN COLLECTING SECONDARY DATA

USE THE HIGH RESOLUTION TO CHECK THE SECONDARY DATA AND VALIDATE THE ACCURACY

OPTIMIZE THE USE OF HIGH RESOLUTION DATA IN OTHER APPLICATIONS:

ENGINEERING APPLICATIONS:

- EDGE OF PAVEMENT
- GUTTER
- MANHOLE
- FIREHYDRANTS
- UTILITY DATA EXTRACTION & MAPPING

UTILIZE HIGH RESOLUTION IMAGERIES IN CLIMATE CHANGE STUDIES:

- LCLUC
- PLANT SPECIES
- IMPERVIOUS SURFACE MAPPING

OPTIMIZATION OF HIGH RESOLUTION IMAGERIES CONT'D..

CLIMATE CHANGE STUDIES CONT'D…

FUTURE RESEARCH PLANS

INTEGRATION OF HIGH RESOLUTION AIRBORNE IMAGERIES AND LiDAR DATA WITH: HYPERSPECTRAL IMAGERIES, TERRESTRAIL LIDAR, GPS, AND GROUND SURVEYED DATA TO EXTRACT THE FOLLOWING :

- SOIL MOISTURE
- VEGETATION GROWTH
- WATER QUALITY
- WATER QUANTITY
- WILDLIFE MAPPING
- PLANT PATHOLOGY

INTEGRATION WITH WEATHER MODELS TO ACCESS THE IMPACTS OF CLIMATE CHANGE ON SOIL, WATER, VEGETATION, AND WILDLIFE

CONCLUSION & RECOMMENDATION

CONCLUSION:

THE PRELIMINARY RESEARCH PROVIDED PROOF OF CONCEPTS FOR POTENTIAL APPLICATIONS OF HIGH RESOLUTION IMAGERIES

RECOMMENDATIONS FOR FURTHER RESEARCH

- INTEGRATION OF HIGH RESOLUTION IMAGERIES WITH LiDAR AND HYPERSPECTRAL IMAGERIES
- FUSION OF AIRBORNE & TERRESTRAIL LiDAR DATA WITH FIELD SAMPLE DATA USING GNSS AND GROUND SURVEYS
- DEVELOPMENT OF SOFTWARE TO HANDLE HIGH PRECISION AND MULTI-SENSOR DATA FOR SECONDARY DATA EXTRACTION
- GAURNTEED ACCURACY OF DATA EXTRACTED FOR ENGINEERING DESIGN OF ECOFRIENDLY INFRASTRUCTURE DEVELOPMENT

DATA OPTIMIZATION FOR CLIMATE RESEARCH :

- PRECISE AND QUANTIFIABLE IMPACT ANALYSIS
- IMPROVED SPECIFICATIONS FOR CLIMATE RESILENT INFRASTRUCTURE DESIGNS
- CLIMATE MITIGATION

ACKNOWLEDGEMENT

THE RESEARCH TEAM ACKNOWLEDGES THE KENTUCKY STATE UNIVERSITY FOR PROVIDING PARTIAL RESEARCH FUNDING AND BERNHEIM ARBORETUM AND RESEARCH FOREST FOR THE LOGISTICS PROVIDED DURING THE FIELD WORK OF THIS RESEARCH.

The presentation team would like to thank the Organizer of JACIE Workshop at the ASPRS Annual Convention 2015.

THANK YOU FOR YOUR ATTENTIONS & PARTICIPATIONS!